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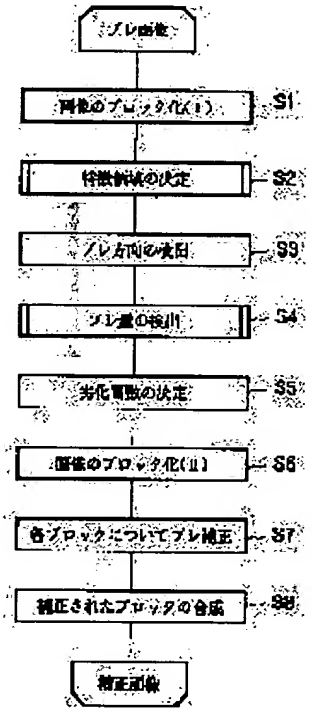
(54) IMAGE PROCESSING METHOD AND SYSTEM

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain a sharp image by detecting a direction and an amplitude of a camera-shake from digital image information to correct a blur in the image.

SOLUTION: Original digital image information is divided into a group of blocks of a prescribed size (S1), a block including most edge components is selected as a characteristic area among the group of blocks (S2), a direction of a camera-shake is detected from image data in the characteristic area (S3), an amplitude of the camera-shake in the direction of the camera-shake of the image data in the characteristic area (S5), a degradation function is obtained, based on the direction and amplitude of the camera-shake (S5), the original digital image information is divided into a 2nd block group (S6), a camera-shake correction arithmetic operation is applied to each block of the 2nd block group by using the degradation function (S7), and the blocks of the 2nd small block group to which the correction arithmetic operation is applied are combined (S8).



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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the image-processing approach and equipment which amend Bure a make clear the image photoed for example, with the stock camera etc.
[0002]
[Description of the Prior Art] Conventionally, in the film-based camera, the video camera, etc., many equipments which detect equipment and the Bure information which amend Bure and are recorded on a predetermined record medium are proposed. These detect vibration (Bure) of a camera using an acceleration sensor etc., and a photographi subject image prevents that of the Bure ** by driving photography optical system based on the detected Bure information. Or based on the Bure information which equipped photography equipments, such as a camera, with the photography section for the Bure information detection for reading the image of a photographic subject, recorded the detected Bure information on record media, such as a film, and was recorded on the record medium, the image processing has amended the Bure image by the regenerative-apparatus side. moreover , in the video camera , the method of unite and shift the image read-out range of a photography sensor to Bure direction and rate be also propos instead of read the Bure information which detected Bure like the above-mentioned approach , recorded the Bure information on the predetermined fields (for example , voice truck etc.) of a video tape or a floppy disk , and be recorded at the time of playback , amend Bure or drive photography optical system . In a video camera, since a photographic subject image is shifted out of the image read-out range of predetermined [in a photography field] wh a photographic subject moves at the time of photography, and image formation is carried out, when this shifted imag is in the photography field of a photography sensor, this approach can shift only the amount which shifted the image read-out range above, and reads a photography image.
[0003]
[Problem(s) to be Solved by the Invention] However, the camera was equipped with each equipment for detecting su Bure compensators and Bure information. When the equipment for detecting the Bure compensator and the Bure information was formed in a camera, the optical system for amendment, its driving gear, and the photography section for the Bure information detection had to be prepared, and there was a problem of enlargement of a camera or increa of weight.
[0004] Moreover, also in the approach of shifting the image read-out range of the above-mentioned photography sensor, in order [which responded to detection of the shift amount for the Bure amendment, and a shift amount] to read and to require modification control of the range, control and a configuration were complicated and there was a problem of the formation of an expensive rank of a camera.
[0005] Moreover, although it was asking conventionally once it changed image information, such as RGB, into the frequency domain as the approach of detecting the direction of Bure, and Bure's width of face, or an approach of amending Bure, there were problems, like data-processing time amount becomes long with complication of data processing, and lack of memory space.
[0006] This invention can amend Bure at the time of playback, without having been made in view of the above-mentioned conventional example, and bringing about enlargement and the formation of an expensive rank of a came and it aims at offering the image-processing approach which can amend the Bure image for a short time, without causing lack of increase of image-processing time amount and the memory space of an image processing system for

Bure amendment at the time of playback.
[0007]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, the image-processing approach of invention consists of the following configurations. Namely, it is the image-processing approach which amends the blurring component contained in digital image information. (a) Divide the original digital image information into the block group of predetermined size, and an edge component is detected for each [which carried out (b) division] the block of every. (c) The block containing most edge components is chosen as a description field from block groups. (Detect the direction of blurring from the image data of said description field, and blur from the image data of the (e) aforementioned description field, and an amount is detected. (f) Blur with said direction of blurring, and based on an amount, ask for a degradation function, divide the digital image information of (g) origin into the second block group and each block of the block group of the (h) above second is received. Each block of said second small block group with which it blurred using said degradation function, the amendment operation was performed, and (i) amendment operation was performed is compounded.
[0008] Or are the image-processing approach which amends the blurring component contained in digital image information, and it sets to (a) digital image information. The average of the pixel of the predetermined number containing the attention pixel which met in the attention direction is computed as an attention pixel value after an im processing, changing said attention direction about a predetermined field. The difference of the attention pixel value after said image processing and the original attention pixel value detects the greatest direction as a direction of Bure, and sets to (b) digital image information. The average of the pixel of X individual containing the attention pixel whic met in the direction detected in Process a It computes as an attention pixel value after an image processing, changing the value of X about the whole predetermined field. Dispersion in the attention pixel value after said image processin Or it blurs in said digital image information using the degradation function which detects the value of X just before dispersion in the difference of the attention pixel value after said image processing and the original attention pixel va increases rapidly as an amount of Bure, blurs with the direction of the (c) aforementioned blurring, and is calculated from an amount, and an amendment operation is performed.
[0009] Moreover, the image processing system of this invention consists of the following configurations. Namely, a division means to be the image processing system which amends the blurring component contained in digital image information, and to divide the original digital image information into the block group of predetermined size, A divid edge detection means to detect an edge component for every block, A description field selection means to choose the block containing most edge components as a description field from block groups, A direction detection means to det the direction of blurring from the image data of said description field, An amount detection means of Bure to blur fro the image data of said description field, and to detect an amount, A degradation function decision means to blur with said direction of blurring and to ask for a degradation function based on an amount, It has a 2nd division means to divide the original digital image information into the second block group, an amendment means to blur using said degradation function and to perform an amendment operation to each block of said second block group, and a synthe means to compound each block of said second small block group with which the amendment operation was performe
[0010] Or are the image processing system which amends the blurring component contained in digital image information, and it sets to digital image information. The average of the pixel of the predetermined number containin the attention pixel which met in the attention direction is computed as an attention pixel value after an image processing, changing said attention direction about a predetermined field. In a direction detection means by which th difference of the attention pixel value after said image processing and the original attention pixel value detects the greatest direction as a direction of Bure, and digital image information The average of the pixel of X individual containing the attention pixel which met in the direction detected by said direction detection means It computes as an attention pixel value after an image processing, changing the value of X about the whole predetermined field. Dispersion in the attention pixel value after said image processing, Or an amount detection means of Bure to detect t value of X just before dispersion in the difference of the attention pixel value after said image processing and the original attention pixel value increases rapidly as an amount of Bure, It has an amendment means to blur in said digi image information using the degradation function which blurs with said direction of blurring and is calculated from a amount, and to perform an amendment operation.
[0011] Moreover, the computer-readable memory of this invention consists of the following configurations. Namely division means by which a computer divides the original digital image information into the block group of

predetermined size, A divided edge detection means to detect an edge component for every block, A description field selection means to choose the block containing most edge components as a description field from block groups, A direction detection means to detect the direction of blurring from the image data of said description field, An amount detection means of Bure to blur from the image data of said description field, and to detect an amount, A degradation function decision means to blur with said direction of blurring and to ask for a degradation function based on an amount, A 2nd division means to divide the original digital image information into the second block group, The program for realizing an amendment means to blur using said degradation function and to perform an amendment operation, and a synthetic means to compound each block of said second small block group with which the amendme operation was performed, to each block of said second block group is stored.
[0012] Or the average of the pixel of the predetermined number which contains the attention pixel which met in the attention direction in digital image information by computer In a direction detection means by which compute as an attention pixel value after an image processing, changing said attention direction about a predetermined field, and the difference of the attention pixel value after said image processing and the original attention pixel value detects the greatest direction as a direction of Bure, and digital image information The average of the pixel of X individual containing the attention pixel which met in the direction detected by said direction detection means It computes as an attention pixel value after an image processing, changing the value of X about the whole predetermined field. Dispersion in the attention pixel value after said image processing, Or an amount detection means of Bure to detect t value of X just before dispersion in the difference of the attention pixel value after said image processing and the original attention pixel value increases rapidly as an amount of Bure, An amendment means to blur in said digital image information using the degradation function which blurs with said direction of blurring and is calculated from a amount, and to perform an amendment operation is realized.
[0013]
[Embodiment of the Invention] [The gestalt of the 1st operation]
The picture reproducer which is the 1st operation gestalt of <configuration of picture reproducer> this invention is explained. Drawing 2 is the block diagram showing the configuration. In drawing, the input section 101 incorporates the digitized digital image information which was recorded with the camera etc. For example, what is necessary is ju to read the recorded digital image information from a camera as it is, if cameras are equipments which memorize an image as digital image information, such as a digital still camera and a digital camcorder. Moreover, if it is a film-ba camera etc., digital image information will be inputted through the process which once digitizes an image.
[0014] CPU102 performs processing including processing of the Bure amendment mentioned later according to the program in which it was stored by program memory 105, and controls the whole picture reproducer. The storage section 103 reads digital data from dismountable storages, such as a flexible disk, and an optical disk, a magneto-opt disk, or writes in. The data stored in this storage are files, such as a program for performing digital image informatio and the Bure amendment procedure mentioned later. The digital image information under processing is developed by the image memory 104. A display 106 displays the digital image information developed by the image memory 104 a visible image if needed.
[0015] Since the component of the picture reproducer of this drawing 2 is also a component with which a general-purpose computer is equipped, this picture reproducer is realizable with a general purpose digital computer.
<the principle of the Bure amendment> -- the Bure amendment is explained here. Although Bure's amendment is performed about the color component of each RGB in a RGB color space, since it is easy, the image-processing operation to R component is explained henceforth. Therefore, each of below-mentioned image (pixel) data, BUREDETA or degradation functions, etc. are related with R component. About G and B component, since an imag processing operation is performed by the completely same approach as R component, explanation is omitted.
[0016] If the degradation function with which f (x y) is expressed for a subject-copy image, and the conversion in the Bure image from g (x y) and a subject-copy image is expressed for the Bure image is set to h (x y), the following relation will be realized among these images.
[0017]
[Equation 1]

$$g(x,y) = \iint h_{xy}(x-x',y-y')f(x',y')dx'dy'$$

[0018] It is expressed by the following formulas by digital image processing.

[0019]
[Equation 2]
$$g(i,j) = \sum_k \sum_l h_{ij}(i-k, j-l) f(k,l)$$

[0020] However, [0021]
[Equation 3]
$$\sum_k \sum_l h_{ij}(k,l) = 1$$

[0022] It comes out. In these formulas, the pixel data g of the Bure image (i, j) show that the pixel data f in a subject copy image (i, j) are generated in response to the effect of the pixel data f (k, l) of locations (k, l) other than a locatio (i, j). The above-mentioned degradation function hij shows the rate of the effect which image data f (k, l) has on ima data f (i, j) in a subject-copy image.
[0023] By the way, since the pixel data of the Bure image are generated in response to the effect of the pixel data around a subject-copy image, the number of pixel data which constitutes a subject-copy image becomes larger than t number of data which constitutes the Bure image. That is, the size of a subject-copy image becomes larger than the s of the Bure image. The pixel data of the field which does not overlap the Bure image are contained as an unknown, a unknowns increase more than the number of simultaneous equations, and it becomes impossible for this reason, to calculate a solution. Therefore, the pixel data of the both ends of the Bure image shall be substituted as dummy data the above-mentioned strange pixel data, and the solution to shall be calculated.
[0024] When the Bure image has the pixel of a mxn individual and simultaneous equations are built paying attention the element which constitutes 1 pixel, a subject-copy image is set to x and b, then Bure image x' are expressed with t following equations in a degradation function. However, e pixels of dummy data shall be substituted for a longitudin direction in d pixels and a lengthwise direction.
[0025]
[Equation 4]
$$x_i' = \sum_{j=0}^{m \times n-1} (b_{m \times n \times t+j} \cdot x_j) \quad (i = 0 \sim (m-d)(n-e)-1)$$

[0026] In order to restore a subject-copy image from the Bure image shown by the above-mentioned formula, a degradation function is again given to the Bure image.
[0027] This is explained using an example. Drawing 5 is drawing for explaining an example of the Bure amendment Since it is easy here, the block of the Bure image is considered as the matrix of three-line three trains, and it is referr to as X0, X1, --, X8 toward the right and down from an upper left element. The direction of Bure receives horizontal and when 0 [whenever] and the amount of Bure are 2 [a pixel], it is influenced by the pixel component which adjoins an attention pixel horizontally. If it assumes that Bure is caused by the uniform motion of photography equipment fo the simplification of processing, since the effect affect an attention pixel is equal, the degradation function in this cas is [0028].
[Equation 5]
$$\frac{1}{3}\begin{bmatrix} 0 & 0 & 0 \\ 1 & 1 & 1 \\ 0 & 0 & 0 \end{bmatrix}$$

[0029] It becomes. If a degradation function is given paying attention to the pixel X4 of the center of a matrix, blurre attention pixel X4' will be set to X4'=b0, X0+b1, X1+b2, X2+b3, X3+b4, X4+b5, X5+b6, X6+b7 and X7+b8, and X from a formula 4. If a formula 5 is applied as this degradation function x4'=b0, X0+b1, X1+b2, X2+b3, X3+b4, X4+ X5+b6, X6+b7 and X7+b8, X8 =0, X0+0, X1+0, X2+ (1/3), X3+ (1/3), X4+ (1/3), X5+0, X6+0 and X7+0, X8 It becomes =(1/3) - (X3+X4+X5).
[0030] Now, if the same degradation function is again given to this Bure image here, it will become x4"=(1/3) - (X3'+X4'+X5'). In the same way as X4', X3'=(1/3) - (X2+X3+X4), Since it is given with X5'=(1/3) - (X4+X5+X6) x4"= (1/3) {(1/3) -(X2+X3+X4) +(1/3) -(X3+X4+X5) +(1/3) - (X4+X5+X6)} It becomes = (1/9) (X2+2, X3+3, X4+

and X5+X6). namely, -- a pixel -- X -- four -- degradation -- a function -- giving -- obtaining -- having had -- Bure -- image -- a pixel -- X -- four -- ' -- being the same -- degradation -- a function -- again -- giving -- obtaining -- having a pixel -- X -- four -- " -- a subject copy -- an image -- attention -- a pixel -- X -- four -- being near -- a value -- ***** -- restoring -- having .

[0031] If this is applied to the Bure image of drawing 5 , it is the result of an image-processing operation. x4"=0x60+0x70+0x50+(1/3) x45+(1/3) x65+(1/3) x55+0x65+0x75+0x55 = it is set to 55 and becomes the brightnes value of the pixel X4 to which this was restored. The above is an example and it can be applied [the principle of this restoration cannot be concerned and] in the amount and direction of Bure.

<Bure amendment procedure> drawing 7 - drawing 10 are explained about the procedure of the Bure amendment of image as an example of an image, referring to drawing 1 and the flow chart of drawing 3 -4. In addition, in explanati although the image itself is shown by a diagram, in processing, the digital image information corresponding to the image is processed.

[0032] Drawing 7 shows the Bure image recorded on record media, such as a film. This is stored in an image memor 104, As shown in drawing 8 , it is K [pixel] x L [a pixel] (K and L are an integer). It divides into a small block (step S1), and the digital image information of each block is changed into a brightness value.

(1. Decision of the description field) It is [0033] to the digital image information changed into the brightness value.

[Equation 6]

$$\begin{bmatrix} 1 & 1 & 1 \\ 1 & -8 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

[0034] A ** Laplacian filter is given and an edge component is detected. Next, in quest of the sum of an edge component, the total value makes a large block the description field for every block (step S2 and step S201 of drawin 3).

(2. Detection of the direction of Bure) the description field for which it asked above -- setting -- horizontal -- receivin -- X[-- whenever -- every] (X is an integer) -- a degradation function -- having used -- an image processing -- an operation -- giving . This processing is processing which changes an attention pixel into the average luminance value the pixel contained in the Bure range assumed about the assumed direction of Bure. For example, when the amount o Bure is set to 2 [a pixel], since there is a gap for 2 pixels from an attention pixel, it is the matrix of three-line three trains about a degradation function. The matrix of this degradation function is [0035], if it receives horizontally, for example, is X= 0 times.

[Equation 7]

$$\frac{1}{3}\begin{bmatrix} 0 & 0 & 0 \\ 1 & 1 & 1 \\ 0 & 0 & 0 \end{bmatrix}$$

[0036] It is [0037], if come out, it is and it is X= 90 degrees.

[Equation 8]

$$\frac{1}{3}\begin{bmatrix} 0 & 1 & 0 \\ 0 & 1 & 0 \\ 0 & 1 & 0 \end{bmatrix}$$

[0038] It comes out. Similarly, it can calculate also as X= 45 degrees or 135 degrees. If it carries out like this, Bure o the direction of slant is detectable.

[0039] The amount of Bure = when it is assumed as 2 pixels, if an attention pixel is X= 0 times as a result of the ima processing operation using this degradation matrix, it will become the average of an attention pixel and the pixel of those neighbors, and if it is X= 90 degrees, it will become the average of an attention pixel and the pixel of those upp and lower sides. Moreover, if it is X= 45 degrees and 135 degrees, the average of brightness will be acquired about t list of the pixel of the direction of slant.

[0040] Thus, the value of X is changed and it asks for the sum of the square of the absolute value of the difference of the brightness value of the digital image information obtained by giving a degradation function about each direction,

and the original digital image information before an image-processing operation. When the photoed image has blurre the attention pixel should contain the component of the pixel contained in the Bure width of face along the direction Bure. For example, if it has blurred horizontally, the attention pixel should include the brightness value of the pixel which adjoins horizontally. Therefore, if the assumed direction of Bure and the actual direction of Bure (the direction of Bure at the time of photography of the image of a dimension) are in agreement, there must be few differences of t brightness value of the pixel of the back before giving a degradation function. Then, the difference of the brightness value of the digital image information obtained by giving a degradation function and the original digital image information before an image-processing operation is large, and, moreover, X corresponding to a degradation function with little dispersion is determined as the direction of Bure at the difference. Therefore, the sum of the square of the absolute value of the difference of the brightness value of the digital image information obtained by giving a degradation function and the original digital image information before an image-processing operation is calculated, a X corresponding to a degradation function with which the value serves as max is made into the direction of Bure (ste S3).

(3. Detection of the amount of Bure) now, the description field for which it asked at step S2 in the direction of Bure searched for at step S3 if the description field and the direction of Bure were specified -- receiving -- Y [a pixel] ever (Y is an integer) -- an image-processing operation is performed. About each pixel which calculated, the absolute valu of the difference of a brightness value with this image-processing result of an operation is computed this image-processing operation before, and it asks for the sum of those squares. It computes, while the value of the sum of this square changes the amount of Bure (i.e., while changing the matrix size of a degradation function), and let the amoun of Bure just before that value changes rapidly be the amount of Bure of that image (step S4 and step S401 of drawing 8).

[0041] If the direction of Bure is judged in step S2 to be 0 times, from the amount 1 (a degradation function is 2x2) o Bure for example, for the first time A degradation function is given to the pixel in the description field at intervals of pixels, making it change like the amount 2 (for a degradation function to be 3x3) of Bure, and the amount 3 (for a degradation function to be 4x4) of Bure, and the sum of squares of the difference before and behind that is computed and let the amount of Bure in front of an abrupt change be the amount of Bure of the image. In this way, the direction of Bure and the amount of Bure are determined.

(4. Decision of a degradation function) Next, a degradation function is determined from the direction of Bure and the amount of Bure which were calculated. The array of the element of a degradation function (matrix) is determined fro Bure, and the magnitude of a degradation function (matrix) is determined from the amount of Bure (step S5). Howev by this approach, the photography equipment exercised for uniform velocity linearly within the exposure time, and thinks of Bure of photography equipments, such as a camera, as that from which the direction of Bure does not chan with the locations of an image. Next, how to ask for a degradation function is explained using an example.

[0042] The array of the matrix whose direction of Bure is 0 times when the direction of Bure receives horizontally an Bure's width of face is 2 pixels at 0 times is [0043].

[Equation 9]

$$\begin{bmatrix} 0 & 0 & 0 \\ 1 & 1 & 1 \\ 0 & 0 & 0 \end{bmatrix}$$

[0044] Since the matrix a next door and whose amount of Bure are 2 pixels turns into a matrix of three-line three trai a degradation function is [0045].

[Equation 10]

$$\frac{1}{3}\begin{bmatrix} 0 & 0 & 0 \\ 1 & 1 & 1 \\ 0 & 0 & 0 \end{bmatrix}$$

[0046] It becomes. The array of the matrix whose direction of Bure is 45 degrees when the direction of Bure receive horizontally and Bure's width of face is 2 pixels at 45 degrees is [0047].

[Equation 11]

$$\begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix}$$

[0048] Since the matrix a next door and whose amount of Bure are 2 pixels turns into a matrix of three-line three trai a degradation function is [0049].

[Equation 12]

$$\frac{1}{3}\begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix}$$

[0050] It becomes. The array of the matrix whose direction of Bure is 90 degrees when the direction of Bure receive horizontally and Bure's width of face is 2 pixels at 90 degrees is [0051].

[Equation 13]

$$\begin{bmatrix} 0 & 1 & 0 \\ 0 & 1 & 0 \\ 0 & 1 & 0 \end{bmatrix}$$

[0052] Since the matrix a next door and whose amount of Bure are 2 pixels turns into a matrix of three-line three trai a degradation function is [0053].

[Equation 14]

$$\frac{1}{3}\begin{bmatrix} 0 & 1 & 0 \\ 0 & 1 & 0 \\ 0 & 1 & 0 \end{bmatrix}$$

[0054] It becomes.

If it does in this way and a degradation function is decided, (5. Reblocking and restoration of a subject-copy image) compaction of saving of memory space, and the processing time The digital image information of a processing objec divided into the small block of M [pixel] x N [a pixel] (M and N are an integer) which overlapped the longitudinal direction r pixels at a time mutually in q pixels and a lengthwise direction (step S6), and Bure is amended for every block (step S7). A degradation function is given to each pixel in the way explained to Bure's amendment with the formula 4 or the formula 5 using the degradation function for which it asked by the above-mentioned approach, and pixel is restored.

(6. Reconstruction of an image) Next, q [a pixel] (q is an integer) and a lengthwise direction are made to overlap a longitudinal direction r [a pixel] (for r to be an integer) every, and the block restored in this way is piled up, as show in drawing 9 . Under the present circumstances, the weighting average of the part piled up in order to graduate the kn during a block is carried out. That is, a weight function is hung and added to the pixel which piles up and is put together. First, the 1-dimensional weight function t1 (i) is given by the degree type.

[0055]

[Equation 15]

$$t_1(i) = \begin{cases} \frac{2i}{M-2}; (0 \le i \le q-1) \\ \frac{2(M-i-1)}{M-2}; (M-q \le i \le M-1) \end{cases}$$

[0056] The two-dimensional weight function t2 (i, j) is expressed with the form of the product of a 1-dimensional weight function.

[0057]

[Equation 16]

$$t_2(i,j) = t_1(i) \times t_1(j)$$

[0058] However, about t1 (j), M in a formula is transposed to N. Superposition processing restores an image using th

weight function (step S8). In addition, i and j express the pixel location within a MxN block.
[0059] Experientially, M/2 is used for a longitudinal direction, and, as for the part to pile up, N/2 is used for a lengthwise direction. Moreover, it says that the semantics of formulas 15 and 16 makes weight light for the edge of t block to pile up, and, thereby, the profile of a block is made smooth.
[0060] Drawing 10 shows the image which amended Bure as mentioned above.
[0061] As explained above, even if it does not correspond by the photography equipment side, such as a camera, according to the image-processing approach concerning this invention, Bure can be amended by the processing by th side of a regenerative apparatus. Moreover, in order to amend for every block, memory space for the Bure amendme is not needed in large quantities.
As 2nd operation gestalt of [gestalt of the 2nd operation] this invention, the procedure which used the gradient filter instead of the Laplacian filter at the time of the decision of the description field is explained, referring to a drawing. Although other procedures are the same as that of the 1st operation gestalt, the example which changed the amount o Bure explains with this operation gestalt.
[0062] first it is shown in drawing 8 -- as -- this image -- K [a pixel] L [a pixel] (K and L are an integer) It divides in a small block (step S1), and the digital image information of each block is changed into a L*a*b* color space from th color space of RGB. It is [0063] to the digital image information changed into L*a*b* space.
[Equation 17]

$$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$$

[0064] A ** GURADIANTO filter is given and an edge component is detected. Next, in quest of the sum of an edge component, the total value makes a large block the description field for every block (step S2 and step S202 in drawin 3).
[0065] the description field for which it asked above -- setting -- horizontal -- receiving -- X[-- whenever -- every] (X an integer) -- an image-processing operation -- giving . However, a degradation function is considered as the matrix five-line five trains, using the amount of Bure as 4 [a pixel]. It asks for the sum of the square of the absolute value of the difference of the brightness value of the digital image information before this image-processing operation, and th digital image information of this image-processing result of an operation, and the value of X from which the value serves as max is made into the direction of Bure (step S3).
[0066] Next, the reset action of the subject-copy image by the above-mentioned operation is explained using an example. Drawing 6 is drawing showing the example for explaining an example of an image-processing operation. Here, since it is easy, the block of the Bure image is considered as the matrix of five-line five trains. A degradation function is [0067], when the direction of Bure receives horizontally and 90 [whenever] and the amount of Bure are 4 pixel].
[Equation 18]

$$\frac{1}{5}\begin{bmatrix} 00100 \\ 00100 \\ 00100 \\ 00100 \\ 00100 \end{bmatrix}$$

[0068] Result of a next door and an image-processing operation x4'=b0, X0+b1, X1+b2, X2+b3, X3+b4, andX4+ ... +b22, X22+b23 and X23+b24, X24 =0x60+0x70+(1/5) x45+0x65+0x55+ ... +0x75+0x55 = it is set to 55. Thus, an image has blurring amended and is restored.
[0069] now, the direction of Bure searched for as mentioned above -- setting -- the description field -- receiving -- Y Bure is amended to every pixel] (Y is an integer). Under the present circumstances, changing the amount of Bure, an image processing is performed using the matrix of the degradation function of the magnitude according to the amoun of Bure, and it asks for the sum of the square of the absolute value of the difference of a brightness value with the image-processing result of an operation image-processing operation before. Let the amount of Bure just before the su of this square changes rapidly be the amount of Bure of the image of a processing object (step S4, step S402 of draw

4).
[0070] Next, it asks for a degradation function from the direction of Bure and the amount of Bure which were calculated. The array of the element of a degradation function (matrix) is determined [this] from BURE, and the magnitude of a degradation function (matrix) is determined from this amount of BURE (step S5). However, by this approach, photography equipments, such as a camera, exercised for uniform velocity linearly within the exposure tim and think of Bure of photography equipments, such as a camera, as that from which the direction of Bure does not change with the locations of an image.
[0071] Next, how to ask for the above-mentioned degradation function is explained using an example.
[0072] The array of the matrix whose direction of Bure is 0 times when the direction of Bure receives horizontally an the amount of Bure is 4 pixels at 0 times is [0073].
[Equation 19]

$$\begin{bmatrix} 00000 \\ 00000 \\ 11111 \\ 00000 \\ 00000 \end{bmatrix}$$

[0074] Since the matrix a next door and whose amount of Bure are 4 pixels turns into a matrix of five-line five trains degradation function is [0075].
[Equation 20]

$$\frac{1}{5}\begin{bmatrix} 00000 \\ 00000 \\ 11111 \\ 00000 \\ 00000 \end{bmatrix}$$

[0076] It becomes. The array of the matrix whose direction of Bure is 45 degrees when the direction of Bure receive horizontally and the amount of Bure is 4 pixels at 45 degrees is [0077].
[Equation 21]

$$\begin{bmatrix} 00001 \\ 00010 \\ 00100 \\ 01000 \\ 10000 \end{bmatrix}$$

[0078] Since the matrix a next door and whose amount of Bure are 4 pixels turns into a matrix of five-line five trains degradation function is [0079].
[Equation 22]

$$\frac{1}{5}\begin{bmatrix} 00001 \\ 00010 \\ 00100 \\ 01000 \\ 10000 \end{bmatrix}$$

[0080] It becomes. The array of the matrix whose direction of Bure is 90 degrees when the direction of Bure receive horizontally and the amount of Bure is 4 pixels at 90 degrees is [0081].
[Equation 23]

$$\begin{bmatrix} 00100 \\ 00100 \\ 00100 \\ 00100 \\ 00100 \end{bmatrix}$$

[0082] Since the matrix a next door and whose amount of Bure are 4 pixels turns into a matrix of five-line five trains degradation function is [0083].

[Equation 24]

$$\frac{1}{5}\begin{bmatrix} 00100 \\ 00100 \\ 00100 \\ 00100 \\ 00100 \end{bmatrix}$$

[0084] It becomes.

[0085] It is M [a pixel] about an image because of compaction of saving of memory space, and the processing time with this amendment algorithm. It divides into the small block of N [a pixel] (M and N are an integer) (step S6), and Bure is amended for every block (step S7). The degradation function for which it asked by the above-mentioned approach is used for Bure's amendment.

[0086] As shown in drawing 4 , the block restored by the above-mentioned approach makes q [a pixel] (q is an integ and a lengthwise direction overlap a longitudinal direction r [a pixel] (for r to be an integer) every, and carries out th weighting average of superposition and each block. Like the gestalt of the 1st operation, weighting is carried out usin the weight function of a formula 15 and a formula 16, and a block is piled up.

[0087] The above procedure can attain the same effectiveness as the gestalt of the 1st operation.

[the gestalt of the 3rd operation] -- the 3rd operation gestalt is explained, referring to a drawing.

[0088] As shown in drawing 8 , it is K [a pixel] about this image. L [a pixel] (K and L are an integer) It divides into small block (step S1), and the digital image information of each block is changed into a L*a*b* color space from the color space of RGB. The Laplacian filter shown in the formula 6 is given to the digital image information changed in L*a*b* space, and an edge component is detected. Next, in quest of the sum of an edge component, the total value makes a large block the description field for every block (step S2 and drawing 3 step S203).

[0089] the description field for which it asked above -- setting -- horizontal -- receiving -- X[-- whenever -- every] (X an integer) -- an image-processing operation -- giving . However, a degradation function is considered as the matrix three-line three trains, using the amount of Bure as 2 [a pixel] here. It asks for the sum of the square of the absolute value of the difference of the brightness value of the digital image information before this image-processing operatio and the digital image information of this image-processing result of an operation, and the point that the sum of the square of this absolute value serves as max is made into the direction of Bure (step S3). This is the same as that of th gestalt of the 1st and the 2nd operation.

[0090] Next, the reset action of the subject-copy image by the above-mentioned operation is explained using an example. Drawing 5 is drawing for explaining an example of the Bure amendment. Here, since it is easy, the block o the Bure image is considered as the matrix of three-line three trains. Since a degradation function is the same as that a formula 5 when the direction of Bure receives horizontally and 0 [whenever] and the amount of Bure are 2 [a pixel it is the result of an image-processing operation. x4"=0x60+0x70+0x50+(1/3) x45+(1/3) x65+(1/3) x55+0x65+0x75+0x55 = it is set to 55.

[0091] the direction of Bure searched for above -- setting -- this description field -- receiving -- Y [a pixel] every (Y an integer) -- changing the amount of Bure, it is made to correspond to it, the size of the matrix of a degradation function is changed, and an image-processing operation is performed. It asks for the sum of the square of the absolut value of the brightness value of the image-processing result of an operation, and let the amount of Bure just before th sum of the square changes rapidly be the amount of Bure of the image of a processing object (step S4 and step S403 drawing 4).

[0092] Next, it asks for a degradation function from the direction of Bure and the amount of Bure which were

calculated. The array of the element of a degradation function (matrix) is determined from Bure, and the magnitude o degradation function (matrix) is determined from the amount of Bure (step S5). However, by this approach, photography equipments, such as a camera, exercised for uniform velocity linearly within the exposure time, and thi of Bure of photography equipments, such as a camera, as that from which the direction of Bure does not change with the locations of an image.

[0093] Next, how to ask for the above-mentioned degradation function is explained using an example.

[0094] The direction of Bure receives horizontally, and when Bure's width of face is 2 pixels at 0 times, the array of matrix whose direction of Bure is 0 times turns into the same matrix as a formula 9, and since the matrix whose amo of Bure is 2 pixels turns into a matrix of three-line three trains, a degradation function becomes being the same as tha of a formula 10. The direction of Bure receives horizontally, and when Bure's width of face is 2 pixels at 45 degrees, the array of the matrix whose direction of Bure is 45 degrees turns into the same matrix as a formula 11, and since th matrix whose amount of Bure is 2 pixels turns into a matrix of three-line three trains, a degradation function become being the same as that of a formula 12. The direction of Bure receives horizontally, and when Bure's width of face is pixels at 90 degrees, the array of the matrix whose direction of Bure is 90 degrees turns into the same matrix as a formula 13, and since the matrix whose amount of Bure is 2 pixels turns into a matrix of three-line three trains, a degradation function becomes being the same as that of a formula 14.

[0095] Because of compaction of saving of memory space, and the processing time with this amendment algorithm, is M [a pixel] about this image. It divides into the small block of N [a pixel] (M and N are an integer) (step S6), and Bure is amended for every block (step S7). The degradation function for which it asked by the above-mentioned approach is used for Bure's amendment.

[0096] A longitudinal direction is made to overlap the block restored by the above-mentioned approach r [a pixel] (fo to be an integer) every in q [a pixel] (for q to be an integer) and a lengthwise direction, as shown in drawing 4 , and t weighting average of superposition and each block is carried out. That is, the block which piles up and is put togethe multiplied by the weight function, and the sum is taken. weight -- the price -- as a function, the same function as a formula 15 and a formula 16 is used.

[0097] By the above Bure amendment approach as well as the gestalt of the 1st and the 2nd operation, even if it does not correspond by the photography equipment side, such as a camera, Bure can be amended by the processing by the side of a regenerative apparatus. Moreover, in order to amend for every block, memory space for the Bure amendme is not needed in large quantities. Moreover, since it is easy compared with the 1st or 2nd operation gestalt, the count the time of detection of the amount of Bure can process quickly.

[0098]

[Effect of the Invention] As explained above, this invention can detect the direction of Bure, and the amount of Bure from digital image information, can amend Bure of an image, and can obtain a clear image. Therefore, there is no ne of forming the Bure compensator and the detection equipment of the Bure information in photography equipment lik before, and it can solve the problem of enlargement of photography equipment, increase-izing of weight, or the formation of an expensive rank. Moreover, since an image is divided and Bure is amended, saving of memory space required for compaction and processing of the operation time can be aimed at.

[0099]

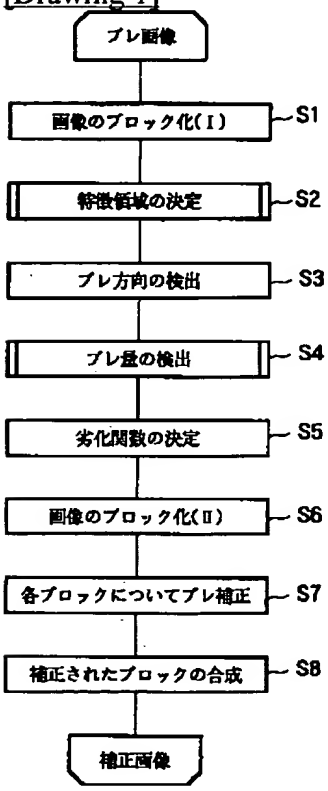
[Translation done.]

* NOTICES *

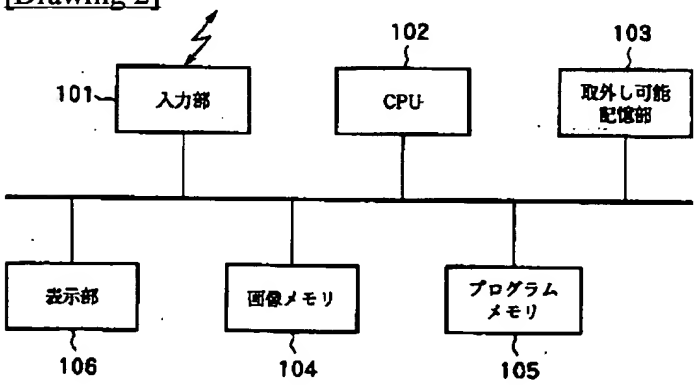
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

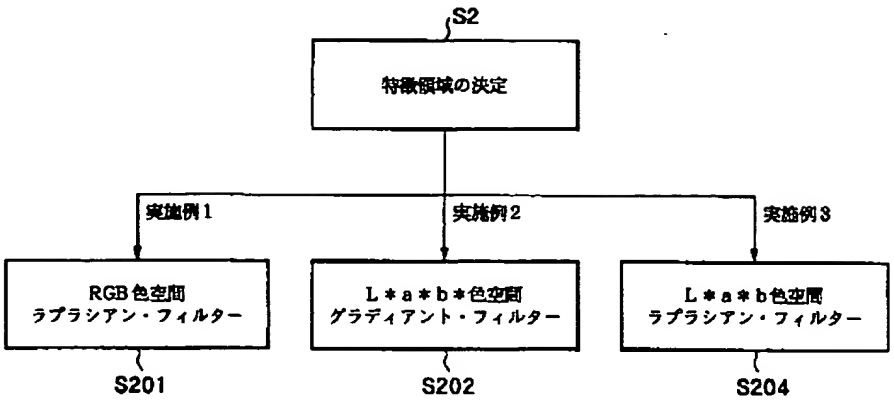
[Drawing 1]



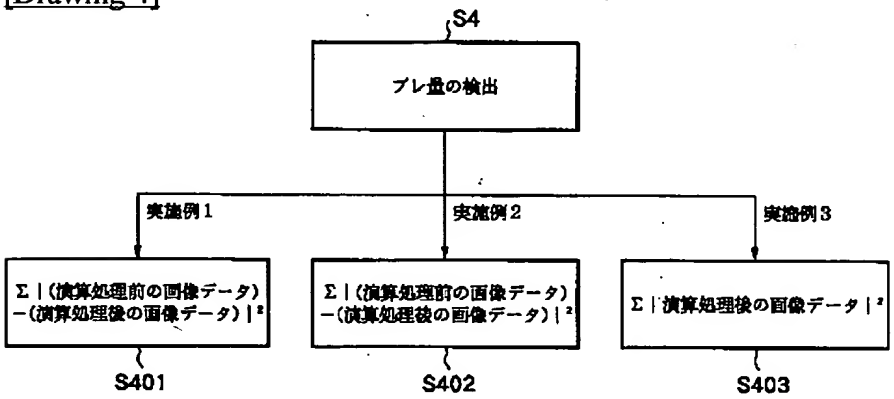
[Drawing 2]



[Drawing 3]



[Drawing 4]



[Drawing 5]

ブレ画像

65	75	55
45	65	55
60	70	50

画像処理演算 ⇒

復元画像

65	75	55
45	55	55
60	70	50

[Drawing 6]

ブレ画像

60	70	45	65	55
50	65	45	70	45
57	60	75	72	50
60	75	55	75	80
63	70	55	75	55

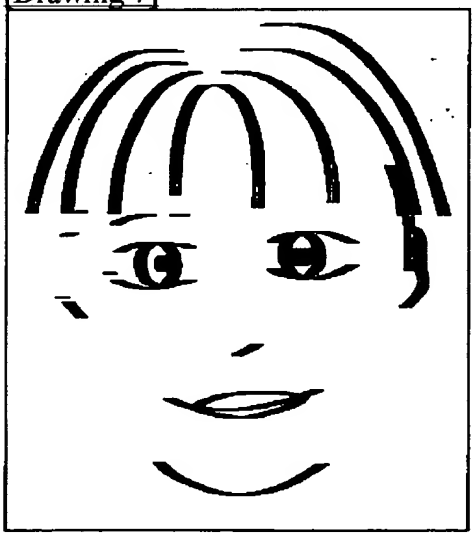
画像処理演算

⇒

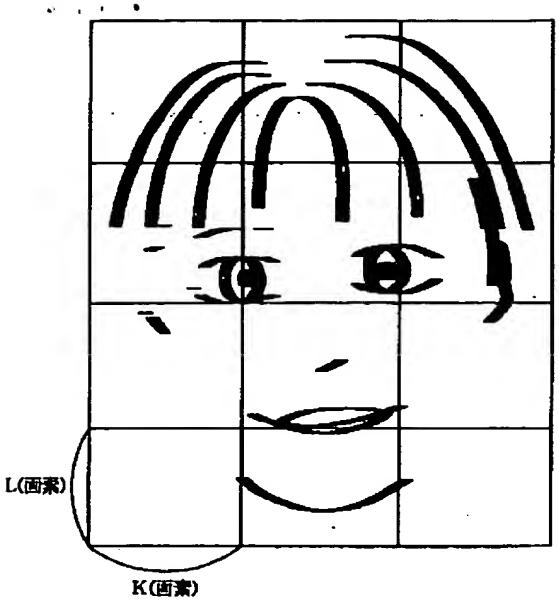
復元画像

60	70	45	65	55
50	65	45	70	45
57	60	55	72	50
60	75	55	75	80
63	70	55	75	55

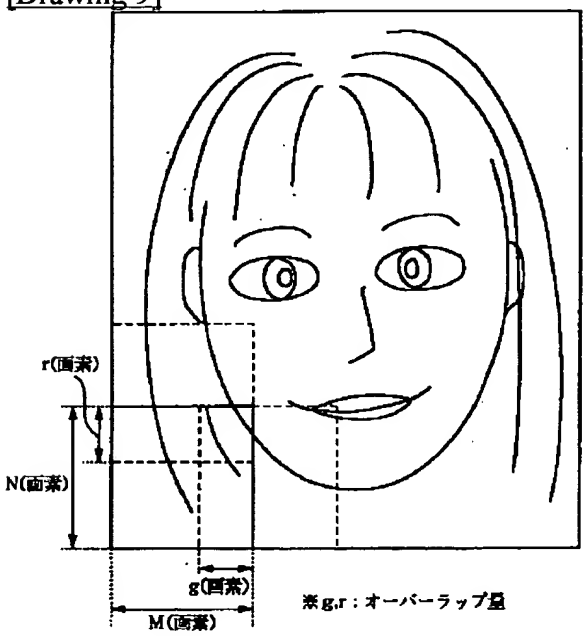
[Drawing 7]



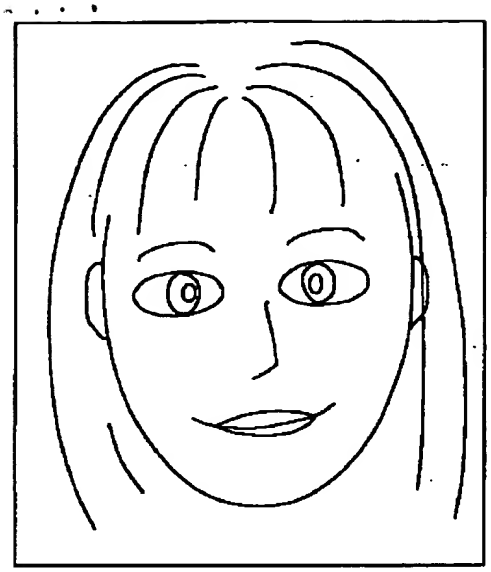
[Drawing 8]



[Drawing 9]



[Drawing 10]



[Translation done.]